DORNO ON THE TECHNIQUE OF THE MEASUREMENT OF SOLAR RADIATION IN RESTRICTED SPECTRAL REGIONS [1]

551.52

By HERBERT H. KIMBALL
[U. S. Weather Bureau, Washington, D. C., December 17, 1924]

The first part of the paper, Heft 8, 234–239, gives the results of spectro-analytical investigations of the transmissibility of different glass and Wratten-gelatine filters for radiation of different wave lengths. Such filters have been employed at Davos and elsewhere to isolate solar radiation in restricted regions of the spectrum, so that the intensity and variability of the radiation at different wave lengths might be determined under different conditions with respect to weather, seasons, solar altitude, geographical position, etc.

As had been anticipated, Wratten-gelatine filters of different colors were found to transmit radiation, not only in a restricted region of the visible spectrum, but also over a considerable range in the ultra-red. It was disappointing, however, to find that the red and also the blue glass screens of Schott transmitted ultra-red radiation also, as shown in Figure 1, and that this radiation could not be eliminated by the use of a water cell 1 cm. thick in conjunction with the glass screens.

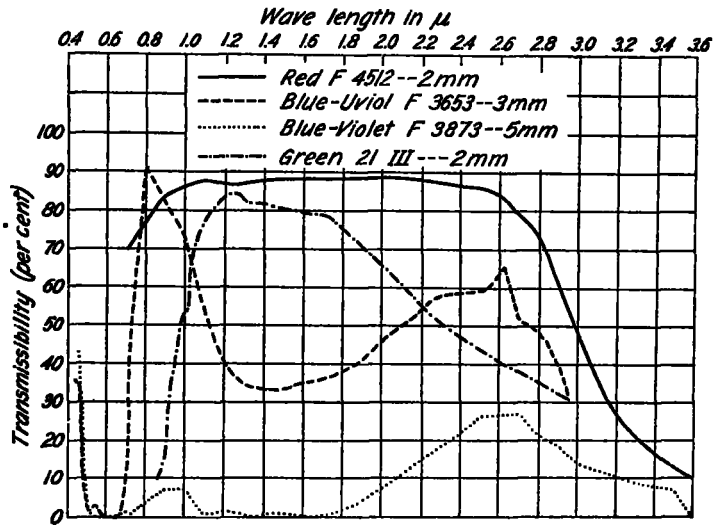

FIG. 1.—Transmissibility of glass filters for radiation of different wave lengths

This last result is not in accord with tests made for the United States Weather Bureau by the United States Bureau of Standards on a combined blue-glass screen (F3873 Schott & Genossen) 2.58 mm. thick, and a water cell 1 cm. thick, as is shown by the transmission coefficients of Table 1.

TABLE 1.—*Transmission of combined blue-grass screen (No. F3873 Schott & Genossen) and water cell 1 cm. thick. Bureau of Standards test No. 3808*

Wave length, μμ	348	350	360	370	380	390	400	410	420	430
Transmission, per cent	0	1	4	11	19	28	30	30	31	31

Wave length, μμ	440	450	460	470	480	490	500	510	565	706
Transmission, per cent	31	30	24	18	11	6	3	1	0.01—	0.02—

Wave length, μμ	800	1,000	1,200	1,400	1,600	1,800	2,000
Transmission:							
Blue glass, per cent	0.0	0.0	0.0	0.0	0.0	0.9	2.6
Water cell, per cent	82.0	68.0	31.5	5.8	2.0	0.0	[1] 0.0
Combined cell	0.0	0.0	0.0	0.0	0.0	0.0	[1] 0.0

[1] Out to 9,000 μμ.

As is pointed out by the author, the results of his tests indicate that caution must be used in interpreting measurements of the intensity of restricted areas of the solar spectrum where color screens have beeen used. See for example his paper in the MONTHLY WEATHER REVIEW, October, 1922, vol. **50**: 515.

This does not apply to measurements by photoelectric cells, however, since these cells are not sensitive to ultra-red radiation.

The second part of the paper, Heft 9, 269–276, gives the results of tests of the sensibility of photoelectric cells to radiation of different wave lengths. Four cells were tested as follows: two potassium cells, one highly evacuated, and one filled with argon gas; two cadmium cells, one large and the other small, the large one obtained after the war, and the small one before the war.

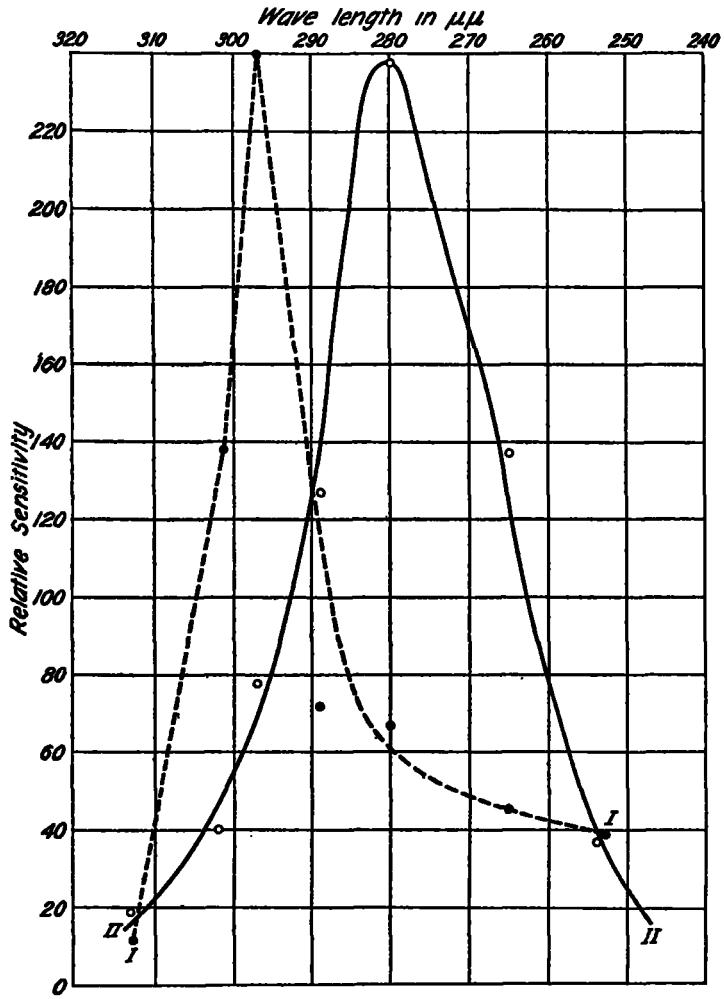

FIG. 2.—Comparison between the sensitivity of the human skin (Curve I) and that of a cadmium cell (Curve II). NOTE.—This cell, obtained by Dorno in 1922, is less sensitive to short-wave radiation than is a similar cell obtained before the war. This is attributed by Dorno to a difference in the glass in the bulbs

The results show that the gas-filled potassium cell has its maximum of sensibility at a slightly longer wave length than the evacuated cell, or at about 450μμ. The curves of sensibility of the two cadmium cells are quite dissimilar. The one procured before the war is relatively more sensitive to short-wave radiation than the other, their maxima occurring at about 265μμ and 280μμ, respectively. The difference is attributed to the difference in transmission of the uviol glass of which the walls of the cells are made, and from this it is concluded that the true maximum of the cadmium cell, if uninfluenced by the glass of the cell walls, would be at

[1] C. Dorno, mit Beträgen von K. W. Meissner und W. Vahle: Zur Technik der Sonnenstrahlungsmessungen in einzelnen Spectralbezirken (Filterdurchlässigkeit, Zellenempfindlichkeit, Michelson-Actinometer). Met. Zeit., 1924, Heft 8: 234–239; Heft 9: 269–277.

a much shorter wave length than that given by these tests. It follows that the cadmium cell promises to be of great value where measurements of ultra-violet radiation (of shorter wave length than 313$\mu\mu$) are desired. It is shown that this is the case in radio-therapy, since it is this short-wave radiation that is most active in producing pigmentation of the skin.

Upon this point Dorno says:

Correct dosage is of the greatest importance in all radio-therapy; so long as the dosage is based upon the degree of pigmentation of the skin there is need for an instrument giving measurement of intensity exclusively for that spectral region which causes pigmentation. In Figure 2 are drawn (1) the curve of sensitivity of the skin according to Hausser and Vahle in degrees of pigmentation, and (2) the sensitivity of the cadmium cell, both determined by quartz lamp radiation. Curve I is displaced somewhat toward the left of Curve II and descends more slowly in the lower portion of the right-hand branch. However, it is apparent that the cadmium cell almost exactly singles out of this long spectrum of the mercury lamp, extending from about 600 to 230 $\mu\mu$ (no account being taken of the ultra-red) only that very narrow spectral section which is essential, so far as actions of pigmentation are to be measured, and that within this very narrow spectral section there is found practically the same distribution of energy as that desirable for evaluating the action upon the skin. Therefore, for use in radiation cures, which takes into account the degree of pigmentation, there can hardly be invented a better dosimeter than the cadmium cell. If we attach importance to a better coincidence in the two curves of Figure 2, which will hardly be of great importance in the matter of correct dosage, it is presumable that this could be attained by choosing for a cell wall a uviol glass which offers a somewhat greater hindrance to the passage of the ultra-violet rays.

Part 3 of the paper, Heft 9 : 276–277 is devoted to a discussion of the Michelson bimetallic actinometer, which has been in use at Davos with satisfactory results since 1909, when two of these instruments were purchased from Moscow. A third was obtained in 1914, likewise from Moscow, and with the three instruments more than a million measurements have been made, at the surface of the earth from sea level to elevations of 3,500 meters, at sea, and on balloon flights, without damage to the instruments, and with little change in their standardization constants. Dorno speaks of them as reaching a stable condition within 10 or 15 seconds after exposure, and following closely all variations in atmospheric transmission. A not irrelevant temperature correction is required by the first two instruments belonging to the type described in Physikalische Zeitschrift, 1908, page 18, and following pages, whereas the third, one belonging to the type described in the Meteorologische Zeitschrift, 1913, page 577, does not show any greater dependence upon the temperature than that cited with examples by Professor Michelson, being thus quite extraordinarily independant of temperature oscillations.

The data relating to the various tests are presented in tables and also in diagrams.

In preparing this summary the writer has made use of an English text prepared by Dorno. This text included Figure II which does not appear in the original paper.

THE PROBABILITIES OF 0.10 INCH, OR MORE, OF RAINFALL AT SPRINGFIELD, ILL.

551.578.1 (773)

By WALTER F. FELDWISCH
[Weather Bureau, Springfield, Ill., August 27, 1924]

The great majority of rain-insurance policies are written on the basis of 0.10 inch precipitation occurring within a specified time. Those who contemplate insuring events frequently inquire of Weather Bureau officials as to what hours during the day rain is most likely to occur, and they especially desire to know the probability of a fall of 0.10 inch or more. Computations showing the average relative depth of fall for each hour are very valuable, but the rate of fall may vary decidedly for the different hours and it may be possible that though rain falls more frequently at certain hours than at others, nevertheless the showers at that particular time of day have a tendency to be so light or of such short duration that frequently the total will not be brought up to the 0.10 inch required to collect the insurance.

Computations have been made for the Springfield, Ill., station, showing the actual percentage of times an amount of 0.10 inch or more of precipitation occurred within specified time limits, and the result is shown in Table 1. As would naturally be supposed, the table indicates that the greater the number of hours included in a period the greater becomes the probability of 0.10 inch within the specified hours for the different times of the day. So, while in May, for instance, in considering six-hour periods, one inspecting the total hourly falls as shown by Table 2 and Figure 1, and the percentages as shown by Table 3, might be inclined to think the hours from midnight to 6 a. m. better for the insured from a monetary point of view than those from 12 noon to 6 p. m. by a margin of 2 to 1, provided rates for all hours are equal, nevertheless this supposition is not borne out by the figures of Table 1. Furthermore, Table 1 shows that in May there is, on the average, less probability of 0.10 inch occurring within six hours following the individual hours 6 a. m. to 11 a. m. than for those of 12 noon to 6 p. m., while Table 3 shows that a slightly greater percentage of the 24-hour amount occurs between 6 a.m. and 12 noon

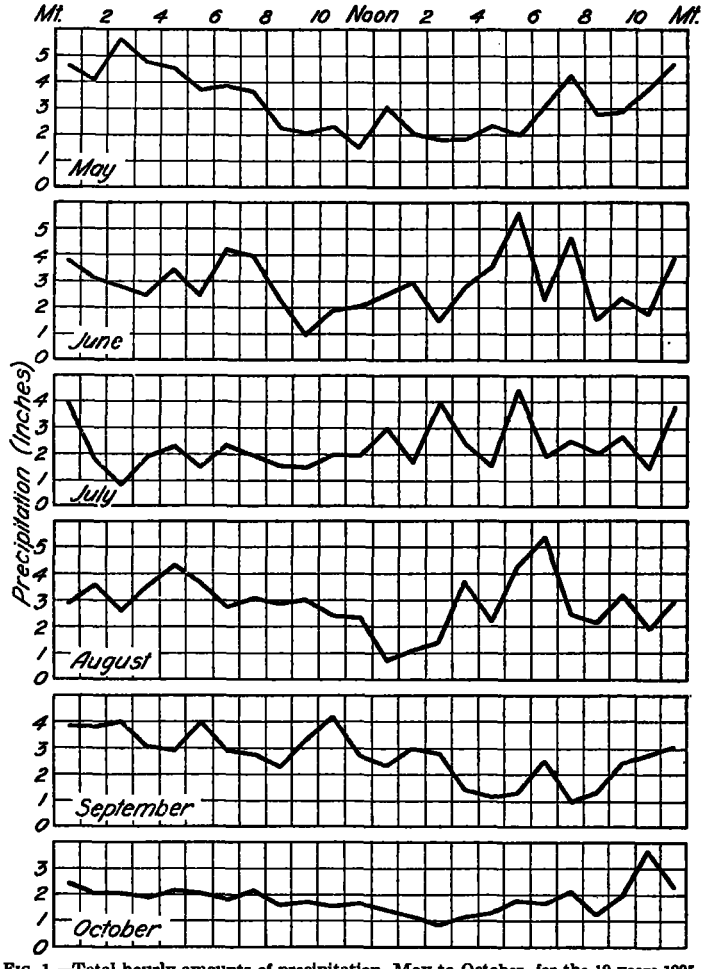

FIG. 1.—Total hourly amounts of precipitation, May to October, for the 19 years 1905–1923, inclusive, at Springfield, Ill. Data from Table 2